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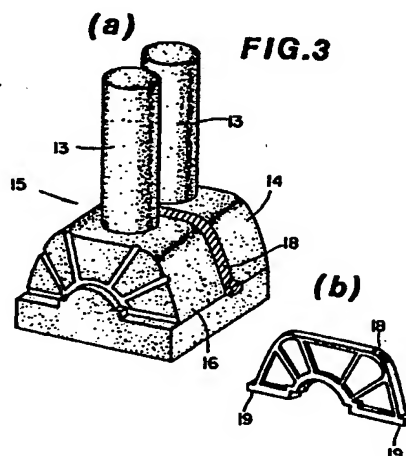
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(84) Molding core for casting engine cylinder block.

(87) A core to be used in cooperation with a mold, for casting an engine cylinder block is made in a single piece. The single piece core comprises a main portion and at least one evaporative pattern (18). The main portion has a shape for forming one or more cylinder bore and a crank chamber (15) of a cylinder block. The evaporative pattern has the same shape as a main bearing portion which is to be formed in a cylinder block and includes a main bearing housing, ribs and lubricating oil passages. The evaporative pattern is embedded in the main body (16), and is made of a material such as foamed polystyrene. When heat is applied, the evaporative pattern dissipates and leaves a cavity in the main body of the core. When casting, this cavity is filled with a molten metal and the main bearing portion is formed in the casting.



## MOLDING CORE FOR CASTING ENGINE CYLINDER BLOCK

### BACKGROUND OF THE INVENTION

5 The present invention relates to a molding core to be used for casting an internal combustion engine cylinder block, and a method for making such a core.

When casting a cylinder block, cores are used to form internal openings such as cylinder bores, a crank chamber, water jackets and lubricating oil passages in a cylinder block casting. Cores are made from a core material such as a mixture of silica sand, a binder and other ingredients by using a core box.

10 A cylinder block casting must be provided with one or more main bearing portions for supporting a crankshaft. Such a main bearing portion has an intricate shape because it includes a housing of a main bearing, ribs and lubricating oil passages. Therefore, if such an intricate main bearing portion is included in a single piece core for forming a crankcase, it is very difficult or impossible to remove such a single piece core from its core box, especially in the case that the single piece core includes an intermediate main bearing portion lying in between outer walls of the crankcase. If, on the other hand, a core piece for forming a main bearing portion is prepared separately

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from a main core for forming a crankcase, it is difficult and time-consuming to accurately and reliably attach the core piece to the main core.

SUMMARY OF THE INVENTION

5           It is therefore an object of the present invention to provide a single piece core including a main portion for making a cylinder bore and a crankcase, and one or more main bearing portions.

10           It is another object of the present invention to provide such a core which has less flashes but has high accuracy and which can be made easily and inexpensively.

          It is another object of the present invention to provide a method for preparing such a core.

15           According to the present invention, a core to be used, in cooperation with a mold, for casting an internal combustion engine cylinder block which has at least one cylinder bore, a crankcase wall for forming a crank chamber and at least one bearing portion for supporting a crankshaft of the engine, comprises a  
20           main body and at least one evaporative pattern. The main body of the core has at least one cylinder portion for forming the cylinder bore of the cylinder block and a crankcase portion for forming the crank chamber. The evaporative pattern has the same shape as the bearing  
25           portion or one of the bearing portions of the cylinder

block. The evaporative pattern is made integral with the main body of the core and is made of a material which is capable of dissipating and leaving a cavity having the shape of the evaporative pattern.

Preferably, the evaporative pattern is embedded in the main body of the core by the process comprising the steps of fixing the evaporative pattern in a predetermined position within a core box for shaping the core, packing a core material from which the core is made, in a cavity formed by the core box and the evaporative pattern, and hardening the core material. The evaporative pattern may have the same shape as the bearing portion which lies in an intermediate position between two ends of the cylinder block spaced along the axial direction of the crankshaft, and the evaporative pattern may be embedded in a corresponding intermediate position in the main body of the core.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing a mold for casting a cylinder block;

Figs. 2a, 2b, 2c are perspective views showing a conventional type core;

Figs. 3a, 3b are perspective views showing the core according to the present invention;

Fig. 4a is a plan view showing a core box for

making a core, Fig. 4b a sectional view taken along the line B-B of Fig. 4a, and Fig. 4c a sectional view taken along the line C-C of Fig. 4a;

5 Figs. 5a, 5b and 5c are sectional views showing a process of fixing the evaporative pattern of the present invention to the core box.

#### DETAILED DESCRIPTION OF THE INVENTION

10 Fig. 1 shows a casting mold for casting a cylinder block of an internal combustion engine. The mold consists of an upper part or cope 1 and a bottom part or drag 2. Between the upper part 1 and the bottom part 2, there are fixed a core 5 for a cylinder block and a core 7 for a water jacket. The cylinder block core 5 has a cylinder portion 3 for forming an engine cylinder and a crankcase portion 4 for forming a crankcase.

15 A molten metal is poured from a sprue 6 into a cavity 8 formed between the mold and the cores. Thus, a cylinder block casting having the same shape as the cavity 8 is made.

20 The cylinder block core 5 is made of aggregate such as silica sand, a binder, an accelerator of hardening and other ingredients. As a core binder, phenolic resin, linseed oil or other appropriate substances are used. The cylinder block core 5 is shaped by using

25 a core box made of metal or other materials.

Fig. 2 shows a conventional design of the cylinder block core 5. The cylinder block core 5 has one or more intermediate bearing portions 9. By the intermediate bearing portion 9 of the cylinder block core 5, a cylinder block casting is formed with an intermediate bearing portion of the crankcase for supporting a crankshaft. The intermediate bearing portion of the cylinder block core 5 has uneven surfaces for making a main bearing housing portion, ribs and lubricating oil passages. Therefore, if the core is made in a single piece including the crankcase portion and the intermediate bearing portion, the cylinder block core 5 can not be removed from its core box in which the core is shaped, after the core is hardened.

Consequently, the cylinder block core is divided into a main body 5a and core pieces 11, as shown in Fig. 2. The main body 5a of the cylinder block core 5 has the cylinder portions 3 and the crankcase portion 4. The main body 5a is formed with flat walls 10. The core pieces 11 have a shape for making the intermediate bearing portion of the cylinder block casting. The core pieces 11 are made by a core box or boxes different from the core box for the main body 5a. The core pieces 11 are attached to the flat walls 10 of the main body by adhesive. Thus, the complete cylinder block core

5 as shown in Fig. 2a is produced. In this case, the main body 5a having the shape shown in Fig. 2c can be removed from its core box by shifting in the direction X or Y as shown by arrows in Fig. 2c. In this method, there is a need for maintaining a high accuracy in assembling the main body 5a and the core pieces 11, so that much time is required for application of adhesive and correction. Furthermore, the cylinder block core of this type is subject to falling off and raise of the core pieces due to insufficient adhesion. Furthermore, cylinder block castings made by using the core of this type have flashes formed by the attaching portion between the main body of the core and the core pieces, so that time consuming trimming job is required.

Fig. 3 shows a cylinder block core 15 embodying the present invention. The cylinder block core 15 has one or more cylinder portion 13 corresponding to the cylinder bore and a crankcase portion 14 corresponding to the crankcase of the cylinder block. The cylinder block core 15 further has a evaporative pattern 18 which is disposed in the middle of the crankcase portion 14. The evaporative pattern 18 has the same shape as the intermediate bearing portion of the casting to be produced. The main body 16 is made of a mixture of aggregate such as silica sand, a binder, an accelerator

and other ingredients, as in the ordinary core molding. The evaporative pattern 18 is made of polystyrene foam or the like which is capable of dissipating or evaporating when heat is applied. As shown in Fig. 3b, the evaporative pattern 18 has the same shape as the intermediate bearing portion having a bearing housing, ribs and lubricating oil passages. In Fig. 3a, the evaporative pattern 18 is incorporated in the main body 16 of the cylinder block core. The evaporative pattern 18 has projecting portions 19 for holding the evaporative pattern 18 in place in the core box for molding the core.

Fig. 4 show a core box 20 for molding the complete cylinder block core 15 shown in Fig. 3a. The core box 20 comprises right/left metallic pattern 21, 22, front/rear metallic pattern 23, 24 and an upper metallic pattern (not shown). The core box 20 made up of the metallic pattern 21 to 24 has a cavity 25 having a shape corresponding to the shape of the cylinder block core 15 including one or more cylinder portions 13, the crankcase portion 14 integral with the cylinder portions and the evaporative pattern 18. Each of the right/left metallic pattern 21 and 22 is formed with a recess portion 26 to be engaged with the projecting portion 19 of the evaporative pattern 18. With the engagement between the projections 19 of the evaporative



pattern 18 and the recesses 26 of the right/left metallic pattern 21, 22, the evaporative pattern 18 is held in position within the core box 20. Movable fixing devices 28 are inserted in holes 28 formed in the right/left metallic pattern 21, 22. The movable fixing devices 28 serve to more rigidly hold the evaporative pattern 18 in the predetermined middle position of the crankcase portion 14. The unshown upper metallic pattern is provided with an opening through which aggregate such as silica sand, a binder and other ingredients are blown into the cavity 25.

The core box 20 is assembled by first putting the right/left metallic pattern 21, 22 together and then attaching the front/rear metallic pattern 23, 24 to the right/left metallic pattern 21, 22. Thus, there is formed, in the core box 20, the cavity 25 having the shape corresponding to the cylinder block core 15 including the one or more cylinder portion 13, the crankcase portion 14 integral with the cylinder portions 13 and the evaporative pattern 18. Within this cavity, the evaporative pattern 18, which is made by forming a foam material such as polystyrene foam into the required shape, is disposed in a predetermined position. The evaporative pattern 18 is accurately positioned by engaging the projections 19 of the evaporative

pattern 18 with the recesses 26 of the core box 20 and by compressing the projections 19 with the unshown upper metallic pattern. It is optional to use the movable fixing devices 27 for fixing the evaporative pattern 18 to the mettalic pattern 21, 22. In this case, the movable fixing devices 27 are inserted into the evaporative pattern 18 in the sequence of Figs. 5a, 5b and 5c, before or after the upper metallic pattern is attached.

Then, the core materials for making the main body 16 of the core are blown by air through the opening formed in the upper metallic pattern, into the cavity 25 formed by the core box 20 and the evaporative pattern 18. The core materials are then hardened and become integral with the evaporative pattern 18. After hardening, the core box 20 is disassembled and the hardened cylinder block core 15 is removed. The core materials may be rammed into the cavity 25 by hand rather than by the air blowing method.

The projecting portion 19 may be made in the form of a belt-like long narrow strip extending over the full circumferential length, and at the same time, the recess portion of the core box may be made in the form of a long groove having the corresponding size and shape. By so doing, the evaporative pattern can

be positioned more accurately, and can be firmly held in position without being shifted during charging of the core materials. When the evaporative pattern is too thin to endure pressures during blowing of the raw materials and there is a possibility of deformation or damage of the evaporative pattern, it is optional to insert a reinforcing metal bar or structure in the evaporative pattern. It is possible to use the movable fixing devices 27 as the reinforcing metal structure. The reinforcing metal structure can be removed after the core has been completed.

The thus fabricated core 15 is removed by detaching the metallic pattern 21-24 and the unshown upper pattern, and is set in a predetermined position between the upper part 1 and the lower part 2 of the master mold shown in Fig. 1. Then, a molten metal is poured from the sprue 6. The poured molten metal fills the cavity 8 and dissolves the evaporative pattern 18. Thus, the evaporative pattern 18 disappears and the space of the evaporative pattern 18 is also filled with the molten metal, so that the produced casting has the intermediate bearing portion having the same shape as the evaporative pattern. A finer surface of the cylinder block casting can be obtained by applying a wash to the evaporative pattern 18. Various hardening

processes are employable for making the main body 16  
of the core. For example, the core can be made by  
hardening oil sand by applying heat. However, the  
carbon dioxide process or the cold box process is preferable  
5 because they make it possible to harden the core at  
nonelevated temperatures. The cold box process utilizes  
polyisocyanate resin and phenolic resin as a binder  
and amine gas such as triethylamine or dimethylamine  
as a curing catalyst. The evaporative pattern 18 may  
10 be dissipated by the heat of a molten metal during  
pouring, or by heating or burning before a molten metal  
is poured. The present invention is available not  
only for a two cylinder engine but also for a one cylinder  
engine, a four cylinder engine and so on.

15 As explained above, the present invention provides  
a single piece core including main body for forming  
a cylinder bore and a crankcase, and the evaporative  
pattern for forming a main bearing portion. Accordingly,  
the present invention can prevent production of flashes  
20 which would be produced when an assembled core is used.  
The present invention can improve the accuracy of a  
produced casting, especially in the main bearing portion.  
The present invention can reduce the finishing or machining  
allowance of a cylinder block casting, and serve to  
25 reduce the weight of an internal combustion engine.

According to the present invention, there is no need  
of production step to attach a separate piece to a  
main core body by adhesive, as required in the conventional  
method, so that the present invention can reduce remarkably  
the man-hour required for making a cylinder block core.

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## WHAT IS CLAIMED IS:

1. A core to be used, in cooperation with a mold, for casting an internal combustion engine cylinder block having at least one cylinder bore, a crankcase wall for forming a crank chamber and at least one bearing portion for supporting a crankshaft, said core comprising:

a main body (16) having at least one cylinder portion (13) for forming the cylinder bore of the cylinder block and a crankcase portion (14) for forming the crank chamber, and

at least one evaporative pattern (18) having the same shape as the bearing portion or one of the bearing portions of the cylinder block, said evaporative pattern being integral with said main portion and is made of a material which is capable of dissipating and leaving a cavity having the shape of said evaporative pattern.

2. The core according to Claim 1, wherein said evaporative pattern is embedded in said main body by the process comprising the steps of fixing said evaporative pattern in a predetermined position within a core box (20) for shaping the core, packing a core material from which the core is made in a cavity formed by the core box and said evaporative pattern, and hardening the core material.

3. The core according to Claim 2, wherein said evaporative pattern is made of polystyrene foam.
4. The core according to Claim 2, wherein said evaporative pattern has the same shape as the bearing portion which lies in an intermediate position between two ends of the cylinder block spaced along the axial direction of the crankshaft, and said evaporative pattern is embedded in a corresponding intermediate position in said main body of said core.
5. The core according to Claim 2, wherein said evaporative pattern has at least one projecting portion (19) by which said evaporative pattern is held in position in the core box.
6. The core according to Claim 2, wherein said evaporative pattern has therein a reinforcing bar.
7. The core according to Claim 2, wherein said evaporative pattern is fixed within the core box by at least one rod (27) which is inserted into said evaporative pattern through the core box wall.
8. A method for making a core to be used, in cooperation

with a mold, for casting an internal combustion engine cylinder block having at least one cylinder bore, a crankcase wall for forming a crank chamber and at least one bearing portion for supporting a crankshaft of the engine, the method comprising the steps of:

preparing a core box having a cavity for shaping a core material into the shape of the core having at least one cylinder portion for forming the cylinder bore of the cylinder block and a crankcase portion for forming the crank chamber,

making at least one evaporative pattern which has the same shape as the bearing portion or one of the bearing portions of the cylinder block, and is made of a material capable of dissipating and leaving a cavity having the shape of said evaporative pattern,

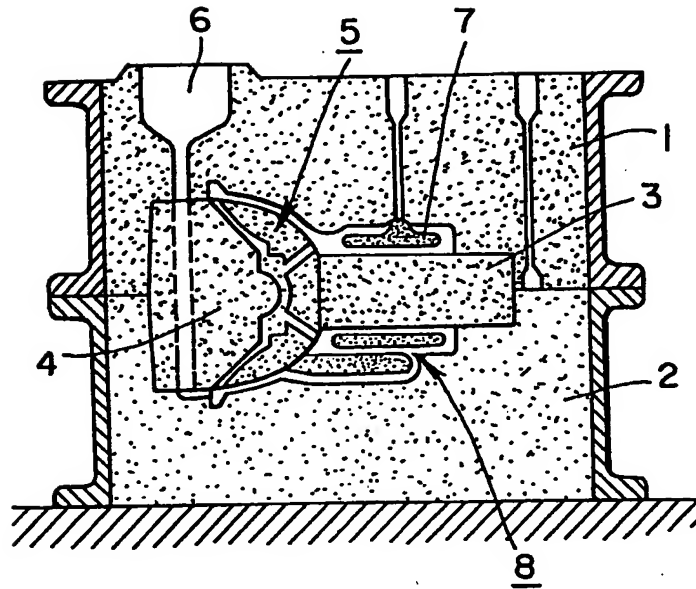
fixing said evaporative pattern in a predetermined position in said cavity of said core box,

packing the core material in said cavity of said core box, and

hardening the core material in said cavity of said core box.

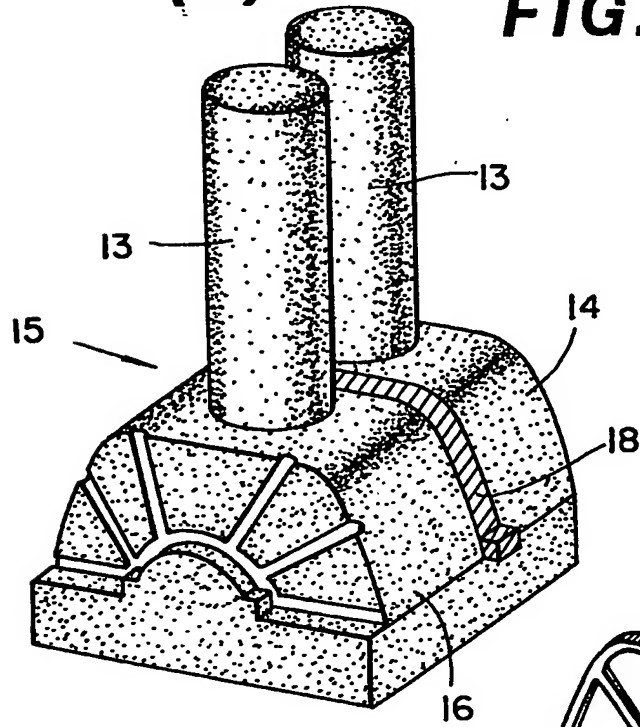


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**FIG.1**

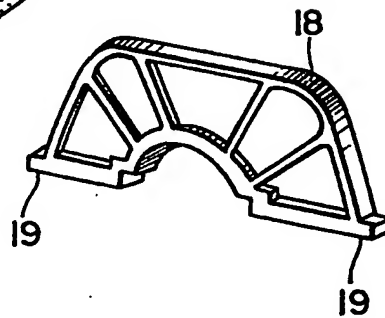


**(a)**

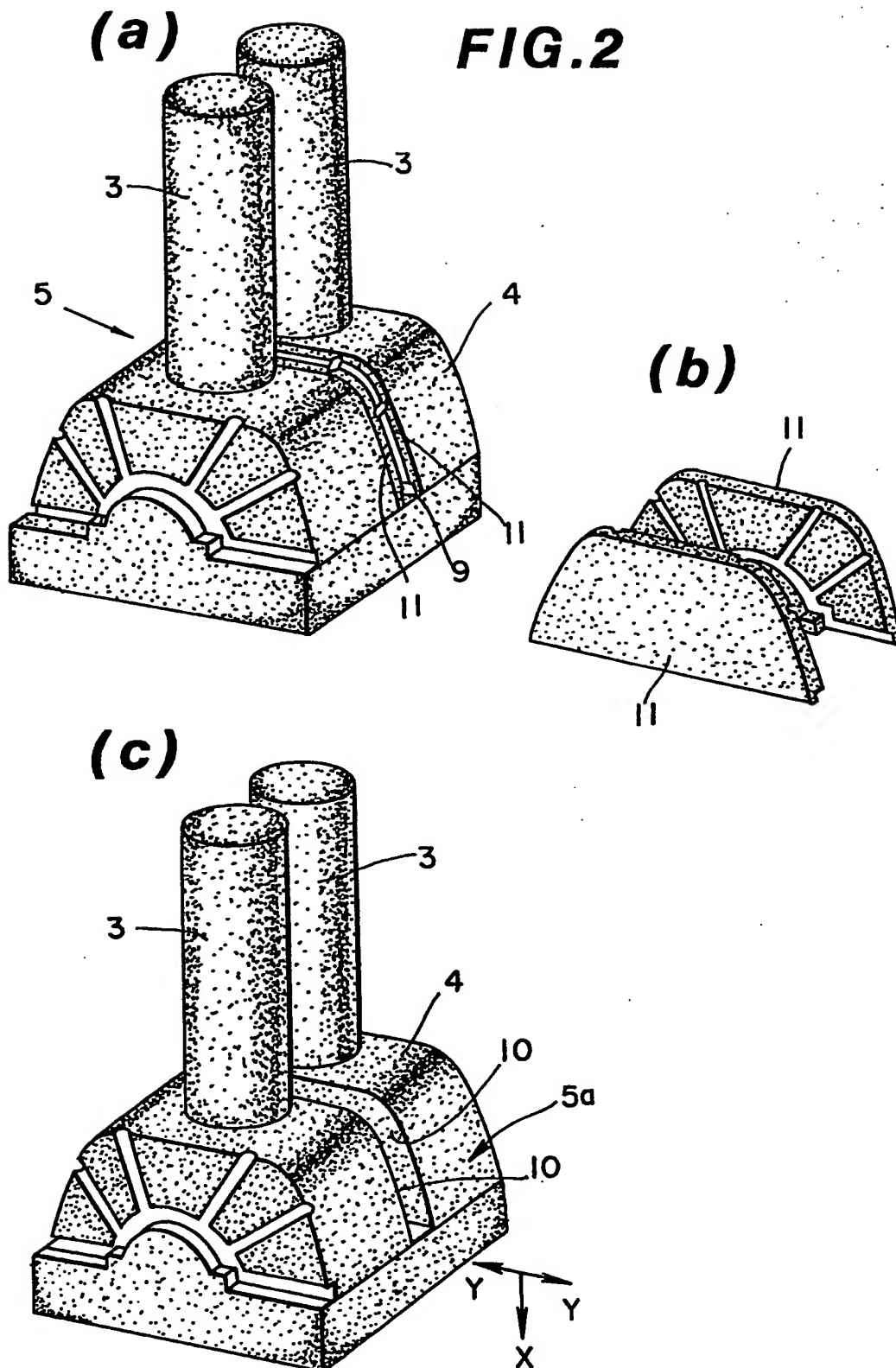
**FIG.3**



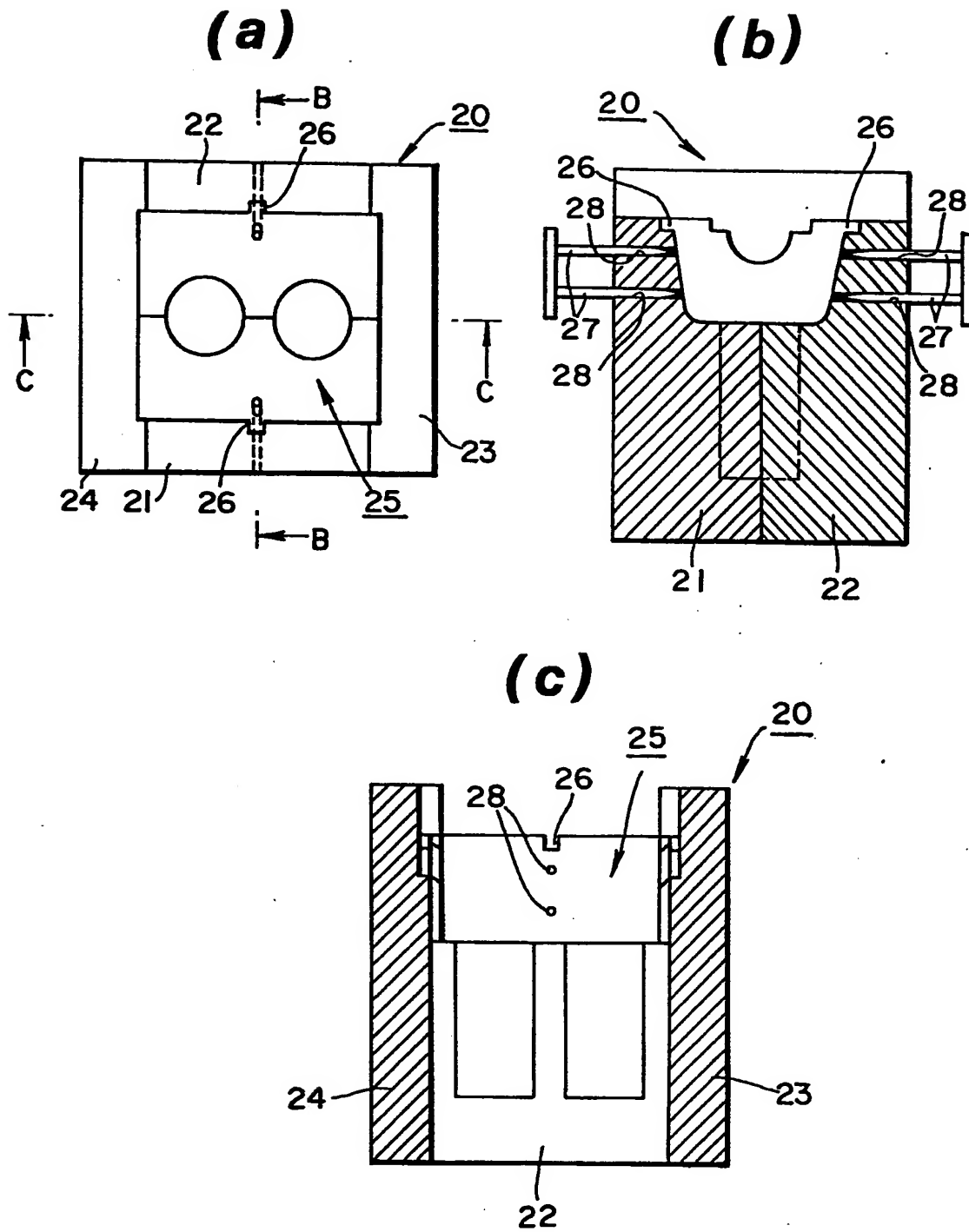
**(b)**



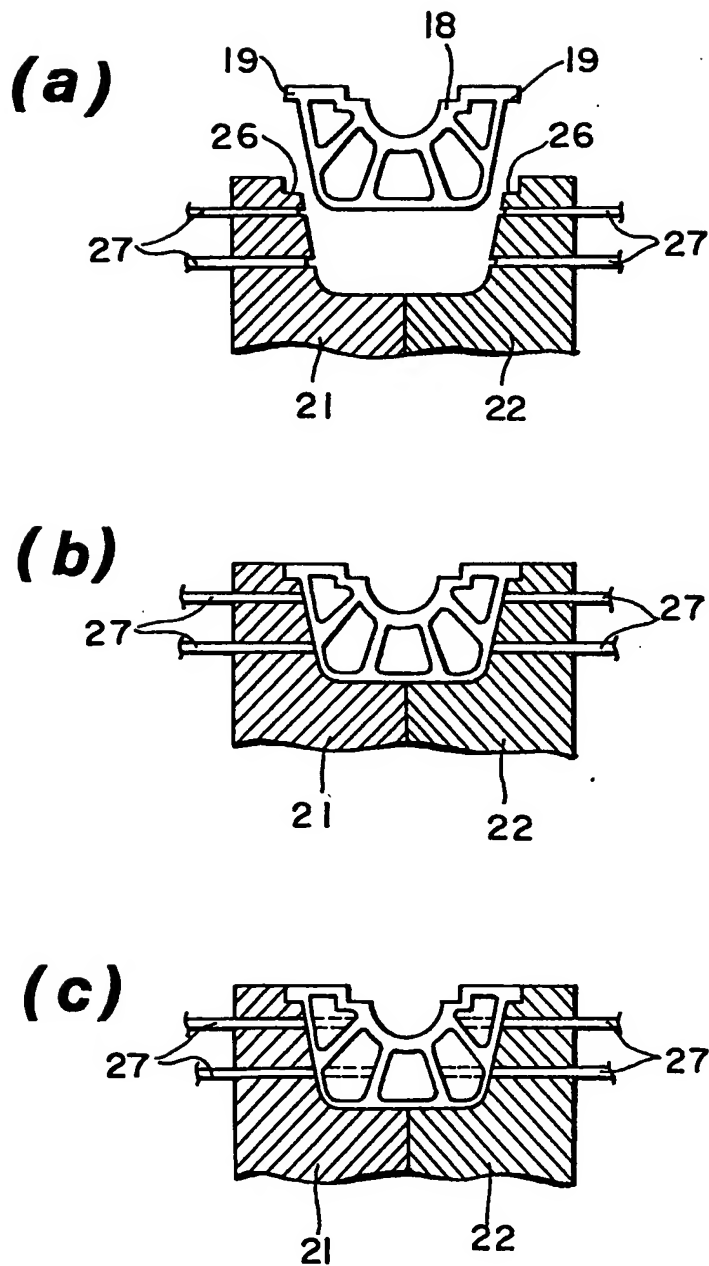
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**FIG. 4**

4/4

**FIG. 5**



European Patent  
Office

# EUROPEAN SEARCH REPORT

0092690

Application number

EP 83 10 3190

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
Y,A	DE-A-3 018 782 (DEERE & CO.) * Claims 1, 2 *	1, 4, 5, 8	B 22 C 9/00 B 22 C 9/04 B 22 C 9/10 B 22 C 9/24
Y,A	DE-A-2 746 233 (DEERE & CO.) * Claims 1, 2, 5 *	1, 2, 5, 8	
A	AT-B- 262 524 (GRÜNZWEIG & HARTMANN AG) * Claim 1 *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
			B 22 C 9/00
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 16-06-1983	Examiner GOLDSCHMIDT G
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	